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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.				
10/553,728	01/03/2006	Karola Richter	HMP 201	1366				
7590 Horst M Kasper 13 Forest Drive Warren, NJ 07059	12/07/2007		<table border="1"><tr><td colspan="2">EXAMINER</td></tr><tr><td colspan="2">GEORGE, PATRICIA ANN</td></tr></table>		EXAMINER		GEORGE, PATRICIA ANN	
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	Application No. 10/553,728	Applicant(s) RICHTER ET AL.	
	Examiner Patricia A. George	Art Unit 1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 29 October 2007.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-10 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☒ Claim(s) 1,2,6,9,10 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 October 2005 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date <u>See Continuation Sheet</u> . | 6) <input type="checkbox"/> Other: _____  |

Continuation of Attachment(s) 3). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :10/23/2007, 12/19/2005,10/14/2005.

## **DETAILED ACTION**

### ***Election/Restrictions***

Applicants' amendment to claim 1 to link Groups I and II, as noted in the request for restriction filed 9/24/2007, to form a single general inventive concept under PCT Rule 13.1 is persuasive, and there for the restriction requirement is withdrawn.

In view of the withdrawal of the restriction requirement, if any claim presented in a continuing application includes all the limitations of a claim that is allowable in the parent application, such claim may be subject to a double patenting rejection over the claims of the parent application. Once a restriction requirement is withdrawn, the provisions of 35 U.S.C. 121 are no longer applicable. See *In re Ziegler*, 443 F.2d 1211, 1215, 170 USPQ 129, 131-32 (CCPA 1971). See also MPEP § 804.01.

### ***Drawings***

The drawings are objected to because figures 12 and 13 are missing a Z value. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes

made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

### ***Specification***

The disclosure is objected to because of the following informalities: In paragraph 0069 of applicants' specification there is reference to Tables 1 and 2, however no such tables can be located in the specification. Appropriate correction is required.

### ***Claim Objections***

The claims are objected to because they include reference characters which are not enclosed within parentheses. Claims 1, 2, 6, 9, and 10, reference figures "A<sub>1</sub>" and "β". Reference characters corresponding to elements recited in the detailed description of the drawings and used in conjunction with the recitation of the same element or group of elements in the claims should be enclosed within parentheses so as to avoid confusion with other numbers or characters which may appear in the claims. See MPEP § 608.01(m).

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-2, 4, 7-8, and all claims dependent on them, are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1 and 2, recites the limitations "the pregiven etching depth" and "the predetermined etching profile" in step d). There is insufficient antecedent basis for these limitations in the claims.

Claim 4, recites the limitations "the interval times" in lines 3-4. There is insufficient antecedent basis for these limitations in the claims.

The term "prolonged" in claims 7 and 8 is a relative term which renders the claim indefinite. The term "prolonged" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-4, and 9 -10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Price (4,639,288) in view of applicants' own admitted prior art J. P. John et al. (Journal electrochemical society, volume 140, No. 9, 1993, 2622-2625) in view of Hull (Properties of Crystalline Silicon. Institution of Engineering and Technology; © 1999; ISBN 978-0-85296-933-5), evidenced by Fedder (6,458,615).

With respect for independent claims 1, 2, and 19, Price (in the abstract, and figs. 3, 4, and 9) teaches and illustrates an article and etching methods for a silicon substrate using a mask to iso-tropically etch the mask to form an undercut, as in step a, and then aniso-tropically plasma etch to deepen the trench, as in step b, to form desired (i.e. defined) sloped angles and depth (col. 3, line 34), and the etching front obtain a new course.

Price is silent as to the undercut being the same width as is the depth of the etching.

With respect to step a) applicants' own admitted prior art, J. P. John et al.: Journal electrochemical society, volume 140, No. 9 (1993), 2622-2625, teaches iso-tropic plasma etching of the silicon substrate, wherein the mask under etching u is approximately equal to the etching depth At. See applicants" para. 0008.

Price is silent with regard to the mask undercut remaining constant during the step of plasma etch; the removal of deposits on the side walls are removing polymers; and the repeating of the etching steps.

With respect to step b) and c) Hull teaches, (on page 833, see 4<sup>th</sup> and 5<sup>th</sup> full paragraphs), DRIE allows vertical etching of silicon, within a few degrees of normal (i.e. , wherein the mask under etching remains constant ), enlargement of the etching depth by aniso-tropic etching with alternating, successively following plasma etching steps and polymerization steps, and wherein the side walls of structure are covered with a polymer with this step, as in step b); Hull teaches (on page 856) it is important to remove the remnants of the dry etch process, such as the said polymers, as in step c).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching a silicon substrate, as Price, to include a step of DRIE, as Hull, because Hull teaches such a known plasma technique applicable to etching silicon and one of ordinary skill in the art would have recognized that applying the known technique would have yielded predictable results.

Further It would have been obvious to one of ordinary skill in the art at the time of invention was made, that the modification of a step of DRIE, as Hull, to a step isotropic etching, as the modified invention of Price, would result in the DRIE etching front obtaining a new course because it would be recognized that similar methods would yield similar results.



As to step d, (and claim 10) the repeating of applicants' steps a) through c) the mere duplication of steps has no patentable significance unless a new and unexpected result is produced.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching, as the modified invention of Price, to include the repeating of steps a) through c), as applicants' claimed limitation, because the mere duplication of steps has no patentable significance unless a new and unexpected result is produced.

Price is not explicit about etching until the predetermined etching profile has been reached.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching, as Price, to include the desired result of etching until the predetermined etching profile has been reached, as applicants' claim, because similar method would yield similar results.

With respect to claim 3, Price teaches, in col. 3, lines 20-25, that the silicon substrate is iso-tropically etched in a SF<sub>6</sub> - plasma.

In re claim 4, Price teaches use of low pressure for DRIE, however is silent with regard to the exact range of process pressures. See full para. 0003 of page 833, and the table on page 835.

Further, Fedder provides evidence of pressures encompassed by applicants' range, for the plasma etching of silicon. See col. 5, line 40-45.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching silicon, as Price, to include applicants' claimed range of pressures for the process gases are from 1.0 to 5.3 Pa (7.5 to 39.7 mtorr), because Price teaches use of low pressures and one skilled in the art would have the skill to understand applicants' range is a low pressure, and Fedder provides evidence which provide one skilled with motivation to be obvious to attempt such a range.

Price teaches the quantity of material removed over a period of time, and that etching is parameter may be adjusted for desired result, however is silent with regard to process time, as in claim 4. See full para. 0004 of page 833.

It would have been obvious to a person having ordinary skill in the art at the time the invention was made to interval times amount to 3 to 12 seconds in the aniso-tropic etching process, such as Price, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 105 USPQ 223 (CCPA 1955).

***Claim Rejections - 35 USC § 103***

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Price, applicants' own admitted prior art J. P. John, and Hull , as applied to claims 1-4 and 9-10 above, further in view of Khajehnouri (6,117,786).

Price fails to teach the polymer is removed by oxygen plasma.

Khajehnouri teaches the well known art of the removal of the polymer performed by way of an O<sub>2</sub> - plasma. See col. 4, lines, 3-14.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching polymer as Price, to include an effective method is oxygen plasma, because use of methods proven effect are cost saving and one skilled in the art would be motivated to try methods known to be effective.

***Claim Rejections - 35 USC § 103***

Claims 6-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Price, applicants' own admitted prior art J. P. John, and Hull , as applied to claims 1-4 and 9-10 above, further in view of Richter (Variation of etch profile and surface properties during patterning of silicon substrates; Surface and Coatings Technology ; Volumes 142-144, July 2001, Pages 797-802; Available online 3 September 2001.)

Price fails to teach the slope angle in the etching profile is determined by adjustment of a time ratio between the steps a) (i.e. isotropic etch) and b) (i.e. anisotropic etch and polymer deposition), as in claim 6; a prolonged step b) (i.e.

anisotropic etch and polymer deposition), as in claim 7; and a prolonged step a), as in claim 8.

Richter teaches main steps of anisotropic patterning of silicon with the aid of sidewall passivation, and subsequent isotropic silicon etching to vary the ratio of etching causes drastic changes in tilt angle (i.e. slope angle)(see abstract). Richter teach adjustments to process parameters are critical in the control of the tilt angle (i.e. slope). Richter discusses how process controls such as etching time and species effect the variation of the tilt (i.e. slope) (See 4.1.).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching silicon, as Price, to include adjustments of process controls as a way to control (i.e. determine) the slope angle in the etching profile, as Richter, because adjustments to process control is recognized as part of the ordinary capabilities of one skilled in the art.

Further, It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching silicon, as Price, to include the determination of the slope angle in the etching profile by adjustment of a time ratio between the etching steps (i.e. a process control) as applicants' claimed limitations, because Richter teaches adjustment of process controls will modify (i.e. determine) the slope, and one skilled in the art would recognize the time of the individual steps in an etching method (i.e. time ratio) is a result effective variable which they would have the skill to adjust with a reasonable expectation of predictable results.

***Claim Rejections - 35 USC § 103***

Claims 1-3, and 6-10 are also rejected under 35 U.S.C. 103(a) as being unpatentable over Richter (Variation of etch profile and surface properties during patterning of silicon substrates; Surface and Coatings Technology ; Volumes 142-144, July 2001, Pages 797-802; Available online 3 September 2001.)

With respect to claims 1, 2, and 9, Richter teach article and methods of forming a silicon substrate with positive etching profiles having a defined slope angle and depth (as in claim 10), obtained by plasma etching of the silicon substrate in a plasma etching plant with a generated plasma, wherein the silicon substrate is covered by a mask and the following steps are performed: iso-tropic SF<sub>6</sub> plasma (as in claim 3) etching of the silicon substrate, wherein the mask under etching is approximately equal to the etching depth enlargement of the etching depth by aniso-tropic etching with alternating, successively following plasma etching steps and polymerization steps, wherein the mask under etching remains constant (see fig. 1) and wherein the etching front obtains a new course, and wherein the side walls of structure are covered with a polymer with this step; removal of the polymer [[from]] at the side walls of the structure. See Section and figures in 4.3.

Richter is silent with regard to repeating the steps a) through c) until the predetermined etching profile with the pregiven etching depth has been reached.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching, as the modified invention of Richter, to include the repeating of steps a) through c), as applicants' claimed limitation, because the mere duplication of steps has no patentable significance unless a new and unexpected result is produced.

Richter is silent with regard to the order of the process steps.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of silicon article by etching methods, as Richter, to include applicants order of the limitation, because Richter's absence of order implies lack of criticality, and absent unexpected results one of skill in the art would have the ability to attempt any combination of the process step with the expectation of yielding predictable results..

Richter fails to teach the slope angle in the etching profile is determined by adjustment of a time ratio between the steps a) (i.e. isotropic etch) and b) (i.e. anisotropic etch and polymer deposition), as in claim 6; a prolonged step b) (i.e. anisotropic etch and polymer deposition), as in claim 7; and a prolonged step a), as in claim 8.

Richter teaches main steps of anisotropic patterning of silicon with the aid of sidewall passivation, and subsequent isotropic silicon etching to vary the ratio of etching causes drastic changes in tilt angle (i.e. slope angle)(see abstract). Richter teach

adjustments to process parameters are critical in the control of the tilt angle (i.e. slope). Richter discusses how process controls such as etching time and species effect the variation of the tilt (i.e. slope) (See 4.1.), as in claims 6-9

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching silicon, as Richter, to include adjustments of process controls as a way to control (i.e. determine) the slope angle in the etching profile, as Richter, because adjustments to process control is recognized as part of the ordinary capabilities of one skilled in the art.

Further, It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching silicon, as Price, to include the determination of the slope angle in the etching profile by adjustment of a time ratio between the etching steps (i.e. a process control) as applicants' claimed limitations, because Richter teaches adjustment of process controls will modify (i.e. determine) the slope, and one skilled in the art would recognize the time of the individual steps in an etching method (i.e. time ratio) is a result effective variable which they would have the skill to adjust with a reasonable expectation of predictable results.

### ***Claim Rejections - 35 USC § 103***

Claim 4 is also rejected under 35 U.S.C. 103(a) as being unpatentable over Richter (Variation of etch profile and surface properties during patterning of silicon substrates; Surface and Coatings Technology ; Volumes 142-144, July 2001, Pages

797-802; Available online 3 September 2001.), as applied to claims 1-3, and 6-10 above, in view of Fedder (6,458,615).

In re claim 4, Richter teaches use of plasma etch, however is silent with regard to the exact range of process pressures and times.

Fedder provides evidence of pressures encompassed by applicants' range, for the plasma etching of silicon. See col. 5, line 40-45.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching silicon, as Price, to include applicants' claimed range of pressures for the process gases are from 1.0 to 5.3 Pa (7.5 to 39.7 mtorr), because Price teaches use of low pressures and one skilled in the art would have the skill to understand applicants' range is a low pressure, and Fedder provides evidence which provide one skilled with motivation to be obvious to attempt such a range.

Richter teaches process time a control variable, see 4.1.

It would have been obvious to a person having ordinary skill in the art at the time the invention was made to include interval times amount to 3 to 12 seconds, as applicants' claim, in the aniso-tropic etching process, as Richter, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 105 USPQ 223 (CCPA 1955).



***Claim Rejections - 35 USC § 103***

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Richter (Variation of etch profile and surface properties during patterning of silicon substrates; Surface and Coatings Technology ; Volumes 142-144, July 2001, Pages 797-802; Available online 3 September 2001.), as applied to claims 1-3, and 6-10 above, in view of Khajehnouri (6,117,786).

Price fails to teach the polymer is removed by oxygen plasma.

Khajehnouri teaches the well known art of the removal of the polymer performed by way of an O<sub>2</sub> - plasma. See col. 4, lines, 3-14

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the invention of etching polymer as Price, to include an effective method is oxygen plasma, because use of methods proven effect are cost saving and one skilled in the art would be motivated to try methods known to be effective.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patricia A. George whose telephone number is (571) 272-5955. The examiner can normally be reached on Mon. - Fri. between 8:00 am and 4:00 pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Patricia A George  
Examiner  
Art Unit 1792

PAG  
11/07

Binh Tran  
Primary Examiner